sented by equation (10). In the example, the parameter A, which is actually f(t) in the heat balance equation, is not a function of (x,y) and is set to a constant value. FIGS. 2 and 3 show the B and C arrays respectively. This is the input for the example. FIGS. 4 and 5 show the solutions obtained for the η and ξ values respectively.

A method of generating indices of a surface for storage in a data base of the present invention comprises the steps of generating from single image of a surface a heat balance equation of the surface and solving the equation from the single image to obtain the heat absorptivity and conductivity of the surface to establish the indices. Such method may further comprise the steps of obtaining a single new image of a surface, generating a heat balance equation of the single new image, solving the new image equation to obtain heat absorptivity and conductivity of the new image to establish indices of said new image, comparing the new image indices to indices stored in the data base; and

generating a probable match between previous stored surface indices and the indices of the new image. Such method may be used wherein the indices for a given surface area are broken into regions and further include the step of comparing individual index regions of a new surface against similar individual stored index regions. Additionally, such method may be used wherein the index regions contain curves and corners and further include the steps of detecting the curves and corners of the index regions computed from the new image, and matching the detected curves and corners against curves and corners of the stored index regions.

Alternatively, a circuit for generating indices of a surface for storage in a data base of the present invention comprises circuitry for generating from single image of a surface a heat balance equation of the surface and circuitry for solving the equation from the single image to obtain the heat absorptivity and conductivity of the surface to establish the indices. Such circuit may further comprise circuitry for obtaining a single new image of a surface, circuitry for generating a heat balance equation of the single new image, circuitry for solving the new image equation to obtain heat absorptivity and conductivity of the new image to establish indices of said new image, circuitry for comparing the new image indices to indices stored in the data base and circuitry for generating a probable match between previous stored surface indices and the indices of the new image. Such circuit may be used wherein the indices for a given surface area are broken into regions and further include circuitry for comparing individual index regions of a new surface against similar individual stored index regions. Additionally, such circuit may be used wherein the index regions contain curves and corners and further include circuitry for detecting the curves and corners of the index regions computed from the new image, and circuitry for matching the detected curves and corners against curves and corners of the stored index regions.

An approach to object classification can be devised by matching material properties, as derived from the image, to a table. From the material absorptivity and conductivity it can be concluded whether the material is metal, sand, grass, water, etc. However, this is not recognition because it is not yet known if a metallic object is a car or a truck, for example. For this we need to do some matching based on the shape of the objects. One way of matching shape is by template matching or generalized correlation. The absorptivity and conductivity images can be correlated with templates of absorptivity and conductivity of objects. The template with the highest correlation value wins and is the recognized object. Unfortunately this method will not work well when the object is partially occluded by clutter in the image.

A system for identifying physical objects from infrared images of said objects of the present invention comprises circuitry for deriving a heat balance equation of the objects, circuitry for generating indices of the objects pertaining to the infrared absorptivity and conductivity of the objects from the derived heat balance equation, and circuitry for comparing individual index regions of the generated indices with similar individual regions of the prestored indices. Alternatively, a method of identifying physical objects from infrared images of said objects of the present invention comprises the steps of deriving a heat balance equation of the objects, generating indices of the objects pertaining to the infrared absorptivity and conductivity of the objects from the derived heat balance equation, and comparing individual index regions of the generated indices with similar individual regions of the prestored indices.

To accomplish recognition in the context of partial object occlusion, an approach based on more locally computed and robust shape cues must be used. For example, corners and curves in the object boundary can be used for model-based matching. In this scheme, boundaries of the object are extracted from the absorptivity and conductivity images. (Note, the boundaries can be extracted more *reliably* here than in the original infrared image because absorptivity and conductivity are more invariant than intensity values in infrared images. For example, absorptivity and conductivity do not change with respect to time of day, the incident solar radiation, etc., and are the same for the hot and cold parts of a material.) Boundaries of the object can be extracted by using standard edge detection schemes, for example, the canny edge detector described in J. Canny's paper "A Computational Approach to Edge Detection," published in *IEEE Transactions on Pattern Analysis and Machine Intelligence,* PAMI-8(6):679–698, Nov. 1986. (The edges in the boundary are expected to be step edges because of the difference between the absorptivity and conductivity of the object with respect to that of the background.) The complementary approach is extracting the boundaries by region segmentation. Corners are found in the boundaries and curves are fit.

A system for identifying physical objects from infrared images of the objects of the present invention comprises circuitry for deriving a heat balance equation of the objects, circuitry for generating indices of the objects pertaining to the infrared absorptivity and conductivity of the objects from the derived heat balance equation, the indices arranged in regions, circuitry for detecting curves and corners from the regions of the indices, and circuitry for matching detected curves and corners of regions of the generated indices with curves and corners of regions of prestored indices. Alternatively, a method of identifying physical objects from infrared images of the objects of the present invention comprises the steps of deriving a heat balance equation of the objects, generating indices of the objects pertaining to the infrared absorptivity and conductivity of the objects from the derived heat balance equation, the